

Solutions to Homework Set #2

Problem 1.

My rest heart rate is 62 beats/min

$$f = 1\text{Hz}$$

The time interval between beats is

$$T = \frac{1}{f} = \frac{1}{1.03} = 0.97 \text{ sec}$$

Problem 2.

$$2\pi f = \sqrt{k/m} \Rightarrow (2\pi)^2 = k/m$$

$$m = \frac{K}{4\pi^2 f^2} = 0.317 \text{ kg}$$

Problem 3.

(a) 4

(b) $\frac{2\pi}{3} \text{ sec} \left[4 \cos 3 \left(t + \frac{2\pi}{3} \right) \right]$

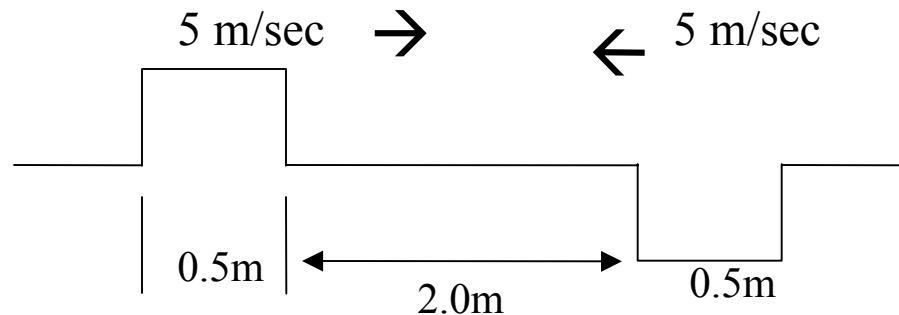
(c) Velocity $4 \cos 3 \left(t + \frac{2\pi}{3} \right) \Rightarrow \frac{dy}{dt} = -12 \sin 3t \Rightarrow 12 \text{ cm/sec}$

(d) Speed $|v| = 12 \text{ cm/sec}$

(e) Acceleration $a = \frac{dv}{dt} = \frac{d^2 y}{dt^2} = -36 \cos 3t \text{ at } t = \frac{\pi}{2}, a \rightarrow 0 \text{ cm/sec}^2$

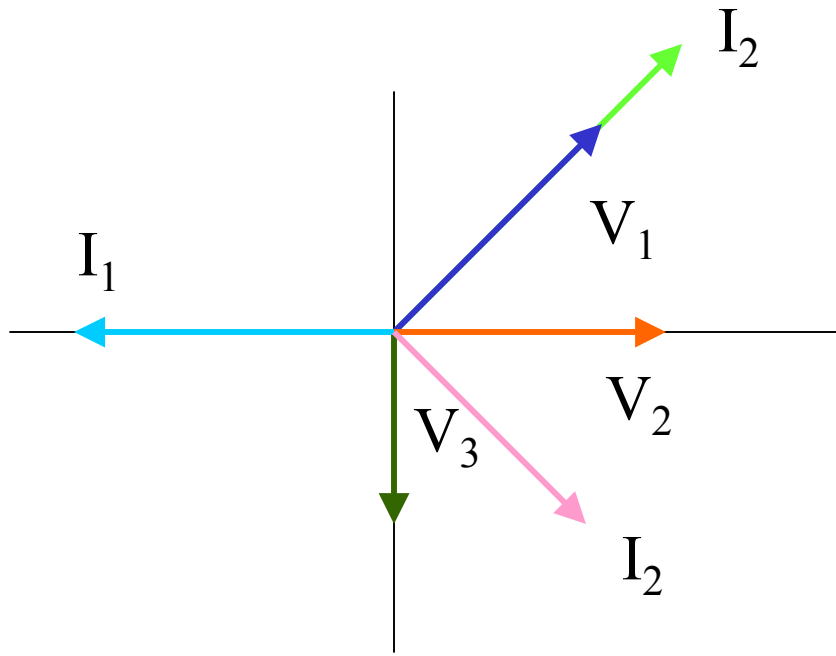
Problem 4.

If the center of the pulses overlap, then the total we have total cancellation. The distance between centers is $d=2.5$ m. The relative velocity is 10 m/sec so,

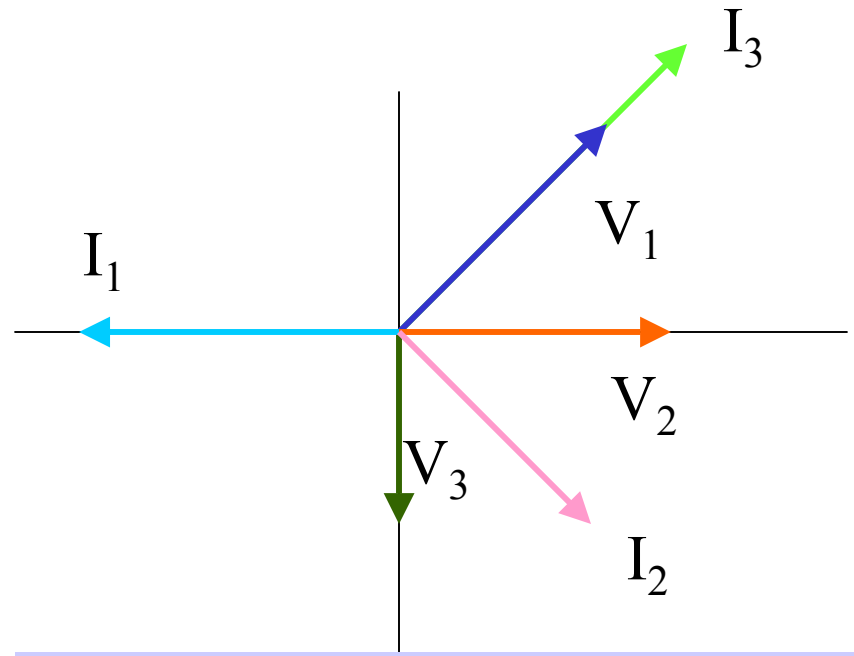


$$t = \frac{d}{v} = \frac{2.5m}{10m/sec} = 0.25sec$$

Problem 5.



$\tilde{V}_1 \angle 45^\circ$ in phase with $\tilde{I}_3 \angle 45^\circ$



$$\begin{aligned}\angle \tilde{V}_1 - \angle \tilde{I}_1 &= 45^\circ - 270^\circ = -225^\circ \\ \angle \tilde{V}_2 - \angle \tilde{I}_2 &= 0^\circ - (-45^\circ) = 45^\circ \\ \angle \tilde{V}_3 - \angle \tilde{I}_3 &= -90^\circ - 45^\circ = -135^\circ\end{aligned}$$

Problem 6.

$$Z_0 = \sqrt{\frac{L}{C}} = \sqrt{\frac{1.43 \times 10^{-3} \text{ H / m}}{8.89 \times 10^{-12} \text{ F / m}}} = 12.7 \text{ k}\Omega$$

$$\beta = \omega \sqrt{LC} = 249 \text{ rad}$$

$$X_C = \frac{1}{\omega C} = \frac{1}{2\pi \cdot 352 \cdot 10^6 \text{ Hz} \cdot 8.89 \cdot 10^{-12} \text{ F}} \sim 60 \Omega$$

$$X_L = \omega L = 2\pi \cdot 352 \cdot 10^6 \text{ Hz} \cdot 1.43 \cdot 10^{-3} \text{ H} \sim 3.2 \text{ M}\Omega$$

$$X_C = \frac{1}{\omega C} = \frac{1}{2\pi \cdot 60 \text{ Hz} \cdot 1 \cdot 10^{-12} \text{ F}} \sim 2.65 \text{ G}\Omega$$

$$X_L = \omega L = 2\pi \cdot 60 \text{ Hz} \cdot 1.0 \cdot 10^{-9} \text{ H} \sim 0.4 \mu\Omega$$